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## INSTITUTIONAL MORTALITY OF THE NEW-BORN

A REPORT ON TEN THOUSAND CONSECUTIVE BIRTHS AT  
THE SLOANE HOSPITAL FOR WOMEN,  
NEW YORK \*

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Much interest has recently been awakened in a study of infant mortality during the early weeks. The importance of such a study is evident for several reasons. According to the best recent statistics available, one-third of the deaths of the first year occur in the first month of life, and seven-eighths of these come in the first two weeks. Using our own statistics to supplement these, of 100 infant deaths during the first year, approximately

33 occur in the first month  
28 occur in the first two weeks  
22 occur in the first week  
13 occur on the first day

This is a concrete statement of the problem of infant mortality from one point of view. While the campaign for the reduction of infant mortality has greatly lowered the deaths from diarrheal and nutritional diseases and has made some considerable impression on respiratory and contagious diseases, thus far it can hardly be said to have touched at all the causes of the large group of deaths in the first month. Finally, at no time of life is diagnosis so difficult and the records of vital statistics so unreliable in giving the exact causes of death as during the first month.

It was thought, therefore, that an analysis of a group of cases from an obstetric hospital would shed considerable light on several phases of the problem under discussion. The records of the Sloane Hospital for Women in New York have been kindly placed at our disposal by Professor Cragin for this study. These records are especially valuable for such an investigation as they are unusually complete and have been kept with great care.

While the number of cases analyzed is small when compared with the statistics of a large city, the hospital figures have the greatly added value of more accurate diagnosis and are in all respects much more reliable than records available from general vital statistics.

\* Read before the American Association for the Study and Prevention of Infant Mortality, at the Fifth Annual Meeting, Boston, Nov. 12-14, 1914.

What is an average or normal mortality among 10,000 births? How do the general figures of the city compare with those of a special institution? How much of the general mortality of the first two weeks could be prevented by proper obstetrics? How much of it is due to malformations and unavoidable accidents of delivery — causes which are beyond the reach of usual or even extraordinary preventive measures? Some of these questions we hoped to answer.

Ten thousand consecutive confinements in the Sloane Hospital for Women have been analyzed for this paper. These occurred during a period of about six and one-half years, ending in October, 1913. They were divided as follows:

Abortions (fetus non-viable, less than 37.50 cm. in length)	253
Stillbirths (fetus viable, 37.50 cm. or over in length)....	429
Living births .....	9,318
	10,000

The hospital receives but few waiting women; nearly all are admitted after labor has begun. Patients are regularly discharged on the fourteenth day, and complete mortality records are therefore possible only for this period. In many cases infants who were ill, not thriving or premature, were kept for a longer time and some interesting facts regarding hospital mortality during a period longer than fourteen days are presented in this report.

In our paper we have first followed the fortunes of the 9,318 infants born alive, and later have analyzed the stillbirths.

The total deaths occurring in the first fourteen days were 291, these being 3.1 per cent. of infants born alive. Of these, 159, or 54.6 per cent., occurred in infants born prematurely; 132, or 45.4 per cent., occurred in infants born at term. Prematurity must, therefore, be recorded as the largest single factor in infant mortality of this period.

The following tabulation gives the exact time of death in premature infants and those born at term:

	Premature	Full Term	Total
Died on first day .....	102	38	140
Died on second day .....	8	10	18
Died under one week .....	135	98	233
Died during second week .....	22	34	56

Of infants born alive, 1.5 per cent. died on the first day; 2.5 per cent. under one week; 3.1 per cent. during fourteen days. Nearly one-half (48 per cent.) of the deaths of the first fourteen days were on the first day.

Curiously, a report by Kerness<sup>2</sup> from the Universitäts Frauenklinik, Munich, for four years, 1907-1911,

1. Twenty-seven died during the first two hours. Were these classed as stillbirths, as is not infrequently done, the total mortality under 14 days would be lowered from 3.1 to 2.8 per cent.

2. Kerness: Ztschr. f. Kinderh., 1912, Referate, iv, 19.

gives exactly the same mortality, 2.5 per cent. of 9,610 living births during the first eight days. The figures given by him for the other periods are not recorded, so that they cannot be compared.

Infants have been classed as premature if they were born after the beginning of the twenty-seventh week of gestation and before term. As reliable information on this point was not usually possible to obtain, the length, weight and general development of the child were also used as a guide. Infants have been considered premature who measured less than 46 cm. (18½ in.) in length, and also those whose weight was less than 2,275 gm. (5 pounds). Only two cases have been included among the prematures in which these figures for weight and length were both exceeded; these were regarded as premature for other reasons.

The measurements of the premature infants were as follows:

Length		Weight	
40 to 44 cm. ....	90 infants	Under 3 pounds....	40 infants
44 to 47 cm. ....	64 infants	3 to 4 pounds .....	72 infants
47 to 48½ cm. ....	10 infants	4 to 5 pounds .....	63 infants
		5 pounds and over ..	8 infants

Only two of this last group were over 46 cm. in length.

The causes of the premature birth in many of the cases were not recorded, but certain facts were obtainable from the records. The age of the mother, the condition of the baby and the number of the pregnancy were usually noted. The age of the mother seemed to be without influence. In only four instances was the mother under 15½ years of age, and in no case under 14 years. Three others were between 17 and 19 years; 103 between 19 and 30 years; 46 between 30 and 40 years, and only 1 was over 40 years. In 90 cases the mother was a multipara; in 70 cases a primipara; one unknown. The baby's condition was recorded as good in only 13 per cent.; fair in 31 per cent.; but poor in 56 per cent.

The labor was spontaneous in 132 cases and induced in 27 cases; in 20 of the latter the reason was toxemia of pregnancy.

We will now pass to a consideration of the causes of deaths during the first two weeks, taking them up in the order of their frequency. These are shown in the accompanying table.

CAUSES OF DEATH DURING FIRST FOURTEEN DAYS\*

	Under One Day	Under 7 Days	Seven to 14 Days	Total Under 14 Days	Grand Totals
Congenital weakness .....	93 2	120 7	14 2	134 9	143
Accidents of labor .....	1 14	1 32	3 13	6 32	33
Pneumonia .....	3 7	3 14	1 7	4 21	25
Atelectasis .....	5 7	6 1	6 1	12 1	13
Congenital syphilis .....	4 4	2 7	3 3	2 10	12
Malformations .....	4 4	2 7	3 3	2 10	10
Hemorrhage .....	4 4	2 7	3 3	2 10	10
Sepsis .....	4 4	2 7	3 3	2 10	9
Asphyxia .....	4 4	2 7	3 3	2 10	8
Accidental .....	4 4	2 7	3 3	2 10	8
Undetermined .....	4 4	2 7	3 3	2 10	8
<b>Totals .....</b>	<b>102 38</b>	<b>135 98</b>	<b>24 34</b>	<b>159 132</b>	<b>291</b>

\* Ten thousand confinements: Abortions, 253, stillbirths, 429; living births, 9,318. (Prematures—heavy type.)

CAUSES OF DEATH DURING FIRST FOURTEEN DAYS

**Congenital Weakness.**—This was assigned as the cause of death in 134 premature infants, and in 9 full-term infants, making a total of 143, or about one-half

(49.4 per cent.) of the total deaths under 14 days. This, then, is one of the very largest and most important factors of infant mortality. Its cause must be sought in the physical condition of the mother during her pregnancy, but not in circumstances connected with delivery.

**Accidents of Labor.**—Accidents of labor were responsible for but 33 deaths, only one of which was in a premature infant. The most important accidents were intracranial hemorrhage and injuries to the head. The single premature infant died from a meningeal hemorrhage after ten hours; no forceps were used, and the diagnosis was confirmed by necropsy. Intracranial hemorrhage in infants born at term was given as the cause of death in 18, nine coming to necropsy. Of these 18 cases, forceps were used in 7, and 10 were breech presentations.

Besides the cases classed as intracranial hemorrhages, injuries to the head were put down as the cause of death in 10 cases, necropsies being made in 3. Of the 10 cases, forceps were used in 8, and 2 were breech presentations. The most frequently mentioned causes of these accidents were difficult deliveries, persistent malpresentations and prolonged labor, the latter usually before admission to the hospital. Combining the above we have intracranial hemorrhage or injury to head or upper part of spine as the cause of death in 29 cases; of which 15 were forceps, 12 were breech deliveries and the diagnosis confirmed by necropsy in 13 cases.

Other accidents of labor causing death in rare instances were: Rupture of the liver, 2 cases; rupture of hematoma of the liver and peritoneal hemorrhage, 1 case; rupture of umbilical cord before labor, 1 case.

In 10,000 deliveries, therefore, accidents of labor caused death in but 0.33 per cent. of the cases. Of the 291 deaths, 33, or 8.8 per cent., were due to this cause. Very few of the accidents of labor mentioned here belong to the preventable causes of infant mortality. That death was due to such causes in but 0.33 per cent. is explicable only by the skilled management of complicated cases. Outside of a special hospital the death-rate from causes of this sort would surely be higher; but in such an institution, even when we consider that a much larger proportion of complicated cases are treated than occur in general practice, deaths from accidents of labor form an astonishingly small fraction of the infant mortality.

**Malformations and Congenital Diseases Other Than Syphilis.**—Of the 12 deaths from these causes, 4 were cardiac malformations; 2, intestinal; 2, of the nervous system, and 4 were recorded as status lymphaticus. Only 2 were in premature infants; of the 10 occurring in infants born at term, 8 were confirmed by necropsy. Monsters have been included among the stillbirths. These figures of course do not represent the number of malformations in 10,000 births, but only those which caused death in the first fourteen days. Four other deaths from malformations occurred in the hospital between the fourteenth and the forty-second day.

**Atelectasis.**—This was a cause of death in 25 infants during the first fourteen days, 4 of these being in premature and 21 in infants born at term. They form a total of 8.6 per cent. of all deaths. Necropsies were obtained in only 5 cases. Atelectasis is also given as a cause of death in 7 infants in the hospital after the fourteenth day. The causes of atelectasis were not determined. All but 3 were normal deliveries, one of

these being a breech, and 2 were cases in which forceps were used.

*Asphyxia Neonatorum.*—Asphyxia was a cause of death in eight born at term; in none of those born prematurely. It caused 2.7 per cent. of all the deaths in the first fourteen days. Six of the deaths occurred during the first six hours and all of them occurred on the first day of life. Among the causes of asphyxia were mentioned: Laryngeal obstruction; knot in the cord; cord tightly around neck; a loop of cord pulled out alongside the head with the forceps; application of the forceps to the after-coming head and inhalation of liquor amnii. In two cases there was placenta praevia.

*Congenital Syphilis.*—The records of the Sloane Hospital offer but a limited field of observation on the results of this disease for two reasons. In the first place, cases which are markedly and definitely syphilitic are not, as a rule, received, although in fact a good many are admitted where symptoms are not very marked. In the second place, the Wassermann test was applied in but a small proportion of the cases used in these statistics. The figures for syphilis, therefore, are much smaller than doubtless would have been obtained were the cases taken from an institution of a different character, or from the city records outside of hospitals.

Congenital syphilis was named as a cause of death in 13 infants during the first fourteen days; 12 were premature and one born at term. In addition, there were 6 others, 3 premature and 3 infants born at term that died from this disease during their stay in the hospital later than the fourteenth day. The diagnosis of syphilis, as indicated above, rested in only a small number on the Wassermann test, but on the other symptoms, such as hydrops of the placenta, definite evidence of syphilis in the mother, pathologic evidence in the placenta, a history of other premature births or previous miscarriages, macerated stillbirths, etc.

*Hemorrhage of the New-Born.*—No deaths in premature infants were recorded from this cause. Ten occurred in infants born at term, forming 3.4 per cent. of the deaths in the first fourteen days. The earliest death occurred on the third day, three each on the fourth and fifth day, one each on the sixth, ninth and eleventh day; there was one also on the sixteenth day. Six received some form of serum treatment. Two had received full doses of human serum without effect; two, single doses of rabbit serum without effect; one, human serum, late and in small doses, without effect; in one other, full doses of rabbit serum, late, without effect.

*Sepsis.*—No premature infants died from this cause; but of those born at term, 9 died from sepsis, making 3 per cent. of the deaths in the first fourteen days. However, 5 additional deaths occurred in the hospital from sepsis between the fifteenth and twenty-fifth days. Of the infants dying before the fourteenth day, cord infection, phlebitis, and abscess of the liver were present in 3 cases; cellulitis of the scalp and infection of the antrum of Highmore in one each, and 2 were of unknown origin. Deaths from sepsis later than the fourteenth day were 5, from the following causes: meningitis secondary to abscess of the scalp, cellulitis of the neck, suppurative mastitis, multiple abscesses; and one, cause not known. Two were forceps deliveries. The 12 deaths from sepsis were scattered through five years, not more than 2 deaths from this

cause occurring in any single year. This is a striking evidence of the efficiency of the asepsis of the institution.

*Pneumonia.*—Pneumonia was the cause of death in 28 infants, or 9 per cent. of those occurring during the first fourteen days, and of 38 infants who remained in the hospital for a longer time, none, however, more than thirty-two days. Thus the total number of deaths from pneumonia was 66, or 17 per cent. of the total 387 deaths which occurred among infants while in the institution. There were twice as many deaths as those due to accidents of labor. Pneumonia thus ranked next to congenital weakness as a cause of death during this period. So far as season is concerned, no special influence is seen on the occurrence of pneumonia; the largest number (39 per cent.) occurred in the fourth quarter of the year.

Several distinct house epidemics of pneumonia were observed. In March, 1909, four deaths occurred from this cause within two weeks; in October, 1910, there were 5 deaths in four weeks; in September and October, 1912, there were 7 deaths in five weeks; in December, 1912, there were 5 deaths in three weeks. Many of these cases were diagnosed as lobar pneumonia and in a large proportion of those coming to necropsy extensive consolidation of the lung was found. In nearly all of the cases, however, catarrhal symptoms of the upper respiratory tract preceded the pneumonia. Only a small proportion of the pneumonias were seen in the first week of life, nearly two-thirds of the deaths occurring between the fourteenth and seventeenth days.

In obstetric hospitals, as in all institutions where infants are brought together, respiratory infections must therefore be reckoned among the greatest dangers to which these small inmates are exposed. More liberal accommodations for babies must be furnished than those provided in most of our obstetric hospitals and greater care to prevent crowding must be exercised. It is also imperative that those infants who are suffering from even the milder types of infection should be promptly and completely isolated from the healthy, and that nurses also with infectious colds should be temporarily relieved from duty.

#### STILLBIRTHS

Probably no part of vital statistics is so unreliable as the records of stillbirths. This is due to many causes. The first is that there is no general agreement among the keepers of records as to what should be called a stillbirth. In New York City and State a case is classed as a stillbirth in which a child has never breathed nor shown other signs of life. This is perhaps the best definition that can be given. There is good ground for the belief that for religious reasons death certificates are sometimes written for stillbirths ascribing the death to other conditions. This would tend to raise slightly the figures for infant mortality during the first days of life. But there is not the slightest doubt that a considerable proportion of stillbirths are never registered at all. A convenient and not an uncommon way of reducing the infant mortality rate is to class as stillbirths all the deaths that occur soon after birth. A clerk of the board of health in a middle western city stated to one of us that prior to 1911 death certificates in his city for infants under one week of age were not filed at all. Some registrars of vital statistics have admitted that they were accus-

tomed to class as stillbirths all children dying in two hours; others, all who died in the first two days. In our figures, had we classed as stillbirths all dying in the first two hours, we would have reduced our mortality 10 per cent. Had we excluded the deaths of the first two days, the mortality would have been reduced 50 per cent. From all these considerations it is evident that it is somewhat difficult to determine with even approximate accuracy what is the proportion of stillbirths to living births. The records of New York City may be taken as fairly trustworthy for a large municipality—they are much more reliable than those of most cities—especially since the classification mentioned above is rigidly adhered to. The past records of many cities are entirely unreliable and we cannot compare infant mortality figures until definite knowledge of what is included as stillbirths has been determined.

The percentage of stillbirths in an institution where careful records are kept is therefore of special interest. In the 10,000 confinements at the Sloane Hospital there were 429 stillbirths or 4.29 per cent. It is interesting to see how this compares with the general records of the city. In 1912 the stillbirths were 4.64 per cent. of the 142,280 total reported births; and in 1913 they were 4.65 per cent. of the 141,765 reported births. These figures are sufficiently close to those from the Sloane Hospital to add much to their reliability. While the records of birth registration in New York are not absolutely complete, the Registrar of Vital Statistics estimates that as a result of agitation and penalties enforced during recent years, over 98 per cent. of the births are now recorded.

In comparing hospital with general statistics it should be remembered that difficult and complicated cases form a much larger proportion of those admitted to a special hospital than occur in general practice. This would have the effect of considerably raising the proportion of stillbirths; since in half these the cause of the stillbirth is prolonged, difficult or complicated labor. But it would be expected that more skilful obstetrics and better care would tend to lower the proportion of stillbirths. That the percentage was reduced to 4.29 at Sloane certainly speaks well for the character of the work done there. We have been unable to obtain comparable statistics from other lying-in hospitals in this country. Kerness, however, has given the figures from the *Universitäts Frauenklinik* in Munich. Among 10,297 confinements in four years ending October, 1911, there were 5.22 per cent. stillbirths. What the percentage would be in our different cities were they all reported and honestly registered, one can only conjecture. Taking the Sloane figures as the basis of an opinion they ought not in general practice to be much over 4 per cent.

*Period of Gestation.*—It was difficult to determine the period of gestation with anything approaching accuracy. This is best estimated by the length of the fetus.

Less than	42.5 cm. (16¾ in.)	56 cases
42.5 to	47.5 cm.	112 cases
Over	47.5 cm. (18¾ in.)	261 cases

More than half these cases were therefore evidently premature infants.

Of the cases, 75 per cent. were admitted during labor and but 25 per cent. were admitted previous to labor. In nearly half the cases (48 per cent.), as the

fetal heart could not be heard, the child was presumably dead on admission; while in 250 (57 per cent.), the heart was not heard during labor. Further evidence of the great number of deaths before admission was the fact that in 162 cases (37 per cent.) the fetus was macerated.

The mode of delivery was as follows:

Normal	189	(44 per cent.)
Version with breech extraction	80	(18 per cent.)
Breech	76	(17 per cent.)
Forceps	59	(13 per cent.)
Craniotomy*	20	(4.6 per cent.)
Cesarean section	5	(1.1 per cent.)

\*Craniotomy was done on only dead fetuses.

Particular interest attaches to the causes assigned for the death of the fetus.

Prolonged, difficult or complicated labor: (Difficult 75; prolonged, 25; placenta praevia, 29; prolapsed cord, 38; cord around neck, 29; accidental hemorrhage, 18)	196	(45 per cent.)
Toxemia of pregnancy	63	(14 per cent.)
Syphilis	40	(9 per cent.)
Prematurity	18	(4 per cent.)
Monsters	7	(2 per cent.)
Unknown	87	(21 per cent.)

#### SUMMARY

The deaths in the hospital during the first fourteen days were 3 per cent. of the living births. For half this number prematurity was responsible.

Forty-eight per cent. of the total deaths and 66 per cent. of those due to prematurity occurred on the first day.

Congenital weakness and atelectasis together made up 58 per cent. of the total deaths.

The mortality from conditions intimately connected with delivery—accidents of labor, hemorrhage, sepsis and asphyxia—together made up but 20 per cent. of the deaths of the first fourteen days.

Malformations and congenital diseases other than syphilis caused 4 per cent., and syphilis 4 per cent.

The only important disease developing after birth was pneumonia.

Stillbirths must be reckoned as one of the large problems in infant mortality; they are one and a half times as many as the deaths from all causes during the first two weeks. Except for the larger rôle played by syphilis, the causes of stillbirth in no way differ from those which produce death during the first days of life.

When we come to consider to what degree preventive measures might influence the mortality of the first two weeks of life, two things stand out prominently: The great number of deaths from congenital weakness can be reduced only by care of the mother during her pregnancy; the number of stillbirths and the deaths from causes connected with parturition can be largely reduced by good obstetrics.

*Uses Served by Morbidity Reports.*—In some diseases morbidity reports make it possible to see that the sick receive proper treatment, as in ophthalmia neonatorum, diphtheria, and, in certain cities, tuberculosis. The reporting of cases of ophthalmia in the new-born makes it possible to save the sight of some infants who would otherwise not receive adequate treatment until after much damage had been done. In diphtheria the health department can be of service in furnishing antitoxin. Some cities furnish hospital or other relief to consumptives who would otherwise be without proper treatment.—John W. Trask, Supplement No. 12, Public Health Reports, April 3, 1914.